PTO 05-5178

CY=SU DATE=20010320 KIND=C1
PN=2 164 260

METHOD OF PRODUCING COMPOSITION MATERIALS HAVING A GRADIENT STRUCTURRE [SPOSOB POLUCHENIYA KOMPOZITSIONNYKH MATERIALOV S GRADIENTNOY STRUKTUROY]

L.M. MOLCHUNOVA, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. July 2005

Translated by: FLS, Inc.

PUBLICATION COUNTRY	(10):	SU
DOCUMENT NUMBER	(11):	2 164 260
DOCUMENT KIND	(12):	C1
PUBLICATION DATE	(43):	20010320
APPLICATION NUMBER	(21):	99113415/02
APPLICATION DATE	(22):	19990623
DATE OF EFFECT	(24):	19990623
INTERNATIONAL CLASSIFICATION	(51):	C 22 C 1/04, 29/00; B 22 F 3/12
PRIORITY COUNTRY	(33):	NA
PRIORITY NUMBER	(31):	NA
PRIORITY DATE	(32):	NA
INVENTORS	(72):	L.M. MOLCHANOV, S.N. KUL'KOV, and S.F. GNYUSOV
APPLICANT	(71):	INSTITUT FIZIKI PROCHNOSTI I MATERIALOVEDENIYA SO RAN
TITLE	(54):	METHOD OF PRODUCING COMPOSITION MATERIALS HAVING A GRADIENT STRUCTURE
FOREIGN TITLE	[54A]:	SPOSOB POLUCHENIYA KOMPOZITSIONNYKH MATERIALOV S GRADIENTNOY STRUKTUROY

The invention concerns metallurgy, methods of producing composite materials for reinforcing different wear-resistant tools.

It is known that the basic deficiency of hard alloys with a high content of the hardening phase is their brittleness. This deficiency limits their area of application in heavily loaded angles of friction with great contact loads, where high viscosity and high hardness are necessary at the same time. The existing technologies for producing hard alloys (sintering molded pieces from a mixture of powders, impregnating casings of refractory materials with an easily melted matrix, and so forth. [V.I. Tret'yakov. Metallokeramicheskiye tverdyye splavy (Metal-ceramic solid alloys), Moscow, Metallurgizdat, 1962, p. 592; L.I. Tuchinskiy, Kompozitsionnyye materialy, poluchayemyye metodom propitom (Composition materials produced by the impregnation method), Moscow: Metallurgiya, 1988, p. 208]) do not simultaneously provide high values of hardness and viscosity. The deficiency of the known methods consists in the fact that there is no possibility for purposeful shaping of the structure of the working surface of the article in the sintering process. Therefore in the majority of cases before further use the working surface of solid alloys are hardened by different technological approaches, ionic implantation, irradiation with powerful ion beams, and so forth, which significantly increases the cost of the tool.

The closest technical solution is a method of producing solid alloys [Russian patent No. 2048266, B22F 3/12, 19931228], including pressing a charge, sintering in a burden of sintered aluminum oxide,

and performing heating at a rate of 35-40 degrees per minute up to 800-850°C with subsequent aging for 30-40 min, and then at a rate of 50-55 degrees per minute to 1350-1400°C and subsequent aging for 50-60 minutes.

The task for the solution of which the invention is directed, consists in the development of a method of producing composition materials having a gradient structure, that have high hardness, strength, and wear-resistance of the working surface of the article. The amount of hardening of the working surface according to the thickness decreases smoothly, reaching the level of the basic volume of the material, and the thickness can be regulated within wide limits. The method proposed is distinguished by the presence of a minimum of production operations for achieving a commercial result. Two production processes - producing a composition material and changing the structure of the working surface - are combined.

The indicated technical result is achieved by the fact that in the method of producing composition materials having a gradient structure, including charge preparation, pressing, and sintering in the burden, the charge is prepared from compounds chosen from the group consisting of carbides, oxycarbides, carbonitrides, nitrides with the addition of steels or alloys containing elements capable of evaporating in the sintering process, and the sintering is performed in a vacuum at 1200-1500°C with aging for 10-300 minutes, one of the surfaces of the press blank being free of burden.

The surface free of burden provides for uniform evaporation of an

element included in the composition of the steel or alloy, which leads to a change of the phase composition, and the mechanical properties of the surface volume of the material.

The choice of temperatures and time is stipulated by the fact that an alloy of high quality is not obtained in the case of heating the alloy to a temperature of less than 1200°C, and at a temperature above 1500°C a significant evaporation of the easily melted component is observed, which leads to the formation of great porosity and a change in the form of the finished article. Aging for 10-300 minutes ensures uniform and high-quality sintering of a specimen with simultaneous regulated thickness of the hardened layer because of evaporation of the easily melted element with the free surface of the article. The necessary alloy quality is not achieved in the case of aging for less than 10 minutes, and further improvement of the properties of the alloy does not take place in the case of aging for more than 300 minutes.

The proposed method is performed in the following way. The pressings are placed into a ceramic or graphite container, covered with powdered aluminum oxide or graphite so that the working surface of the articles was free of burden. Then the articles are heated in a vacuum to 1200-1500°C and aged for 10-300 minutes.

Example of a specific embodiment.

A pressed specimen of a solid WC-steel 110G13 (30% by weight) alloy in the form of a cylinder 25 mm in diameter and 20 mm high was placed in a container 80 mm in diameter and 50 mm high. The specimen

was covered with aluminum oxide so that the top face surface of the cylinder was free of burden. Then the container was placed in a vacuum oven and heated at a rate of 30 degrees per minute to 1350°C and aged for 100 minutes. After aging, the heat was switched off. The increase in the microhardness in the volume of the material near the surface amounts to 1100-1200 MPa in comparison with the basic volume of the solid alloy. The micro-hardness of solid alloys prepared according to the method of producing solid alloys (Russia patent No. 2048266, B 22 F 3/12, 19931228) does not change throughout the entire volume of the article and is equal to 5700 MPa. The thickness of the modified layer of the composition material, depending on the sintering temperature and time, obtained according to the proposed method, is given in the table.

Formulation of Invention:

A method of producing composition materials having a gradient structure, including charge preparation, pressing, and sintering in the burden, wherein the charge is prepared from compounds chosen from the group consisting of carbides, oxycarbides, carbonitrides, nitrides with the addition of steels or alloys containing elements capable of evaporating in the sintering process, and the sintering is performed in a vacuum at 1200-1500°C with aging for 10-300 minutes, one of the surfaces of the press blank being free of burden.

Example	Composition of composition material, % by weight, WC	TLC 110G13		Sintering temperature, °C	Aging time, min t_1	Thickness of modified layer, μm
1	70	-	30	1320	10	50
2	70	-	30	1320	60	750
3	50	-	50	1200	30	500
4	80	-	20	1400	300	2000
5	90	-	10	1500	200	1500
6	-	50	50	1400	120	1200
7	-	50	50	1400	240	1700
8	50	20	30	1380	40	700
9	60	10	30	1350	30	600